PATENT SPECIFICATION

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DRAWINGS ATTACHED

(21) Application No. 38762/67 (22) Filed 23 Aug. 1967
(23) Complete Specification filed 22 Aug. 1968
(45) Complete Specification published 11 Aug. 1971
(51) International Classification C 09 c 1/50
(52) Index at acceptance
C1A K4
F4B A8A1 A8A2 A8L

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1242391

(54) OXIDATION OF HYDROCARBON OILS

(71) We, PHILBLACK LIMITED, of 1 Henbury Road, Westbury-on-Trym, Bristol, a British Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the oxidation of hydrocarbon oils.

Hydrocarbon oils require a theoretical proportion of air for their complete combustion to carbon dioxide and water. When less than the theoretical quantity of air is present, partial oxidation to carbon monoxide may occur and in some cases pyrolysis to the elemental carbon and hydrogen themselves occurs. The free carbon or soot can be collected if it escapes from the flame before reaction with other oxidants. The products obtainable on combustion vary according to the conditions and the nature of the products can be to a large extend controlled by varying the air supply whilst using the same basic apparatus.

According to this invention we provide a reactor for the oxidation of hydrocarbon oils comprising a closed outer tube provided with a head through which may be introduced atomised oil to an ignition zone within the head and adjacent to the end of a refractory tube positioned at least partly within the said outer tube, the opposite end of said refractory tube communicating with a tangentially disposed outlet passage for effluent, a heat exchanger in the outlet passage, the outer tube having an inlet distant from the said head for oxygen-containing gas preheated in the heat exchanger, and said refractory tube within the outer tube being spaced from the side walls of the outer tube so as to permit substantially un-interrupted passage of gas from said inlet to said ignition zone. Preferably the oil is introduced to the ignition zone in a region adjacent to, but outside, the end of the said refractory tube.

Preferably the refractory tube within the outer tube has a thin metal sheath substantially all of which projects into the outer tube, and is spaced by means of water-cooled pins from the side walls of the outer tube. The outer tube may be sealed at the end distant from the head to the refractory tube by means of an insulating seal, and ignition-controlling cooling means may be provided in the refractory tube beyond the confines of the said outer tube.

Consequently, the invention further provides a process for the production of carbon black comprising mixing hydrocarbon oil and an oxygen-containing gas in an ignition zone, passing the products from the ignition zone through a refractory tube and tangential withdrawal of carbon black containing effluent from the said tube, the gas being pre-heated by indirect heat exchange with the effluent after withdrawal of the effluent from the tube prior to the introduction of the gas to the ignition zone through a zone surrounding at least part of the said refractory tube. The pre-heated gas is preferably introduced tangentially to the outer tube of the apparatus, that is to the zone surrounding the refractory tube, thus producing a spin of the gases in the refractory tube.

One form of the invention adapted for the manufacture of carbon black will now be described with reference to the drawings filed herewith wherein:—

Fig. 1 is a plan view, partly in cross-section, of a reactor for carbon black.

Figs. 2, 3 and 4 are cross-sections along the lines II—II, III—III, and IV—IV respectively in Fig. 1.

As shown in the drawings the reactor comprises a sealed outer tube 2 which may be of steel and which may be insulated internally and/or externally, with side walls 4, having at one end a refractory lined head 6 into which passes a burner tube 8 positioned in an inlet aperture 10. The burner tube 8 terminates in an atomising nozzle for atomising the oil sup-

ply with air. The inlet aperture 10 is for the introduction of cooling air.

Within the outer tube 2 is positioned part 12 of a refractory tube, which is spaced from the side walls 4 of the outer tube by means of water-cooled location pins 14. The part 12 is thin in nature and is sheathed in a thin gauge steel tube 16. Differential expansion between the tubes 12 and 16 may be accommodated by use of a complete or partial sandwiched layer of refractory fibre material. The refractory tube extends beyond the end of the outer tube 2 and is continued as a cooling section 18 which is refractory lined and into which projects an axially adjustable water spray gun 20.

The cooling section 18 and outer tube 2 are separated by a seal 22 which seals the end of the outer tube 2 against the walls of the tube 16 to prevent gas or air leakage. Additional seals packed with insulating material may be provided. The outer tube 2 is provided at the end distant from the head 6 with a tangential air inlet port 24 which allows hot air to enter into the outer tube 2 and pass along to the reaction zone adjacent the head 6.

The air entering through the port 24 is preheated by means of the heat-exchange preheater 26 adjacent the cooling section 18 of the reactor and through which flow the effluent gases from the refractory tube 12 to supply heat to the heat exchanger and hence to the air which is to enter port 24. An axial air supply is also introduced into the reactor through the port 28 communicating with inlet aperture 10 which extends through the reactor head 6. If necessary, this air can be introduced tangentially into the port 28 by means of flow-directing tube 29 (see Fig. 2). This is not preheated. Atomising air, used in conjunction with the oil is also preheated. This is done by means of heating tubes 30 wound about the outer tube 2 and through which the atomising air passes before passing to the burner via the duct 32. The oil inlet duct 34 communicates with the burner tube 8. Alternatively other means could be employed to provide an atomised oil supply.

Thus, in operation, hot air enters the port 24 and passes through the outer tube 2 so that it is further heated by the refractory tube 16 before reaching the ignition zone (designated by the numeral 36) and mixing with the oil and air supply. Because at least part of the ignition zone is upstream of the tube 12, the change of direction of the hot air in the region of the ignition zone permits further heat transference. Ignition occurs adjacent the head 6 and the cooling is controlled by the positioning of the spray gun 20 within the cooling section 18. The carbon black product is withdrawn to a suitable collection station beyond the preheater 26. The outlet from the cooling section 18 is tangentially arranged as shown in Figure 4 so that the products pass through the preheater 26 thus allowing heat exchange with the air which enters the reactor through the ports 24. The tangential exit helps to maintain the spin of the gases throughout the reactor. Both the air introduced at 24 and at 28 may have (as shown here) the same spin as the effluent has when being tangentially withdrawn.

The reactor may be used for the production of soot-free combustion products by varying the air to oil ratio. For example, a flow of 700 standard cu. ft. per gallon of oil may be used to produce carbon black whereas the air intake may be stepped up to 2,500 standard cu. ft. per gallon for producing soot-free combustion products. In this case, the refractory lined cooling section 18 and quenching means 20 would not be needed, and the refractory tube could be wholly within the outer tube.

WHAT WE CLAIM IS:—

1. A reactor for the oxidation of hydrocarbon oils comprising a closed outer tube provided with a head through which may be introduced atomised oil to an ignition zone within the head and adjacent to the end of a refractory tube positioned at least partly within the said outer tube, the opposite end of said refractory tube communicating with a tangentially disposed outlet passage for effluent, a heat exchanger in the outlet passage, the outer tube having an inlet distant from the said head for oxygen-containing gas preheated in the heat exchanger, and said refractory tube within the outer tube being spaced from the side walls of the outer tube so as to permit substantially un-interrupted passage of gas from said inlet to said ignition zone.

2. A reactor according to claim 1 in which the oil is introduced to the ignition zone in a region adjacent to, but spaced outside, the end of the said refractory tube.

3. A reactor according to claim 1 or 2 wherein the refractory tube within the outer tube is encased by a thin metal sheath which substantially wholly projects into the outer tube to be exposed to the preheated gas and is spaced from the side walls of the outer tube by means of water-cooled pins.

4. A reactor according to claim 3 wherein the refractory tube is continued axially beyond the outer tube by a separate refractory portion of the same internal dimensions.

5. A reactor according to any one of the preceding claims wherein the outer tube is sealed at the end distant from the head to the refractory tube by means of an insulating seal.

6. A reactor according to any one of the preceding claims wherein ignition-controlling cooling means are provided in the refractory tube beyond the confines of the said outer tube.

7. A reactor according to any one of the preceding claims in which the atomised oil contains atomising air which air is preheated by means of ducts coiled around the said outer tube.

8. A reactor according to any one of the preceding claims wherein the preheated gas is introduced tangentially to the outer tube.

9. A reactor according to claim 8 wherein the effluent from the inner tube is removed tangentially in the same direction of spin as that in which the gas is introduced.

10. A process for the production of carbon black which includes mixing hydrocarbon oil and oxygen-containing gas in an ignition zone, passing the products from the ignition zone through a refractory tube and withdrawing the carbon black-containing effluent tangentially from the said tube, preheating the gas by indirect heat exchange with the effluent after withdrawal of the effluent from the tube and causing this gas to flow to the ignition zone through a zone surrounding at least part of the said refractory tube.

11. A process according to claim 10 which includes introducing the gas into said zone surrounding the refractory tube tangentially to produce a spin of gases in the refractory tube.

12. A process according to claim 11 which includes removing the effluent tangentially in the same direction of spin as that of the gas introduced into the said zone surrounding the refractory tube.

13. A process according to claim 9, claim 10 or claim 11 which includes using a single oil supply.

14. A reactor for the manufacture of carbon black substantially as described herein with reference to the drawings filed herewith.

15. A process for the production of carbon black substantially as described herein with reference to the drawings filed herewith.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1971.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1242391. COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

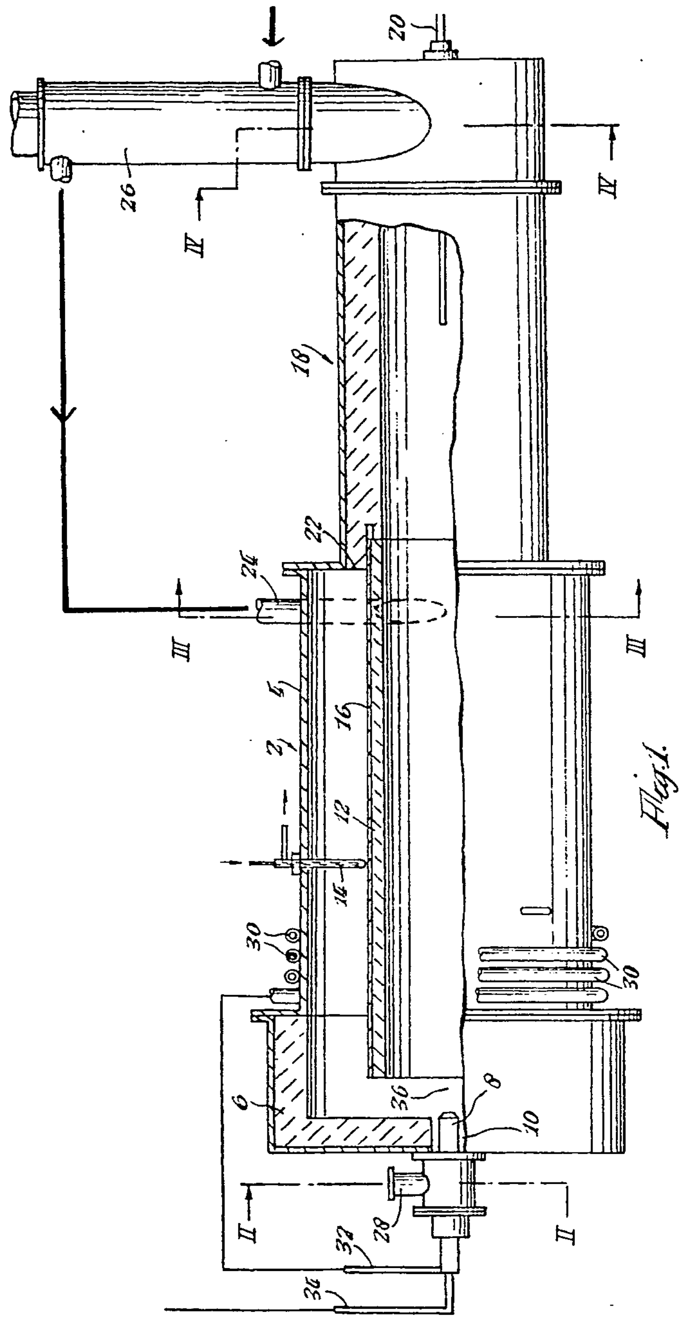

Fig. 1.

1242391 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

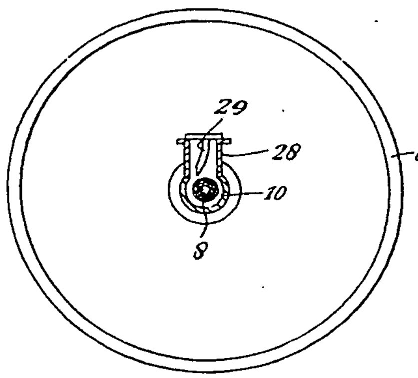

Fig. 2.

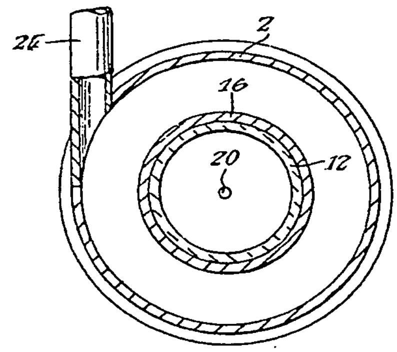

Fig. 3.

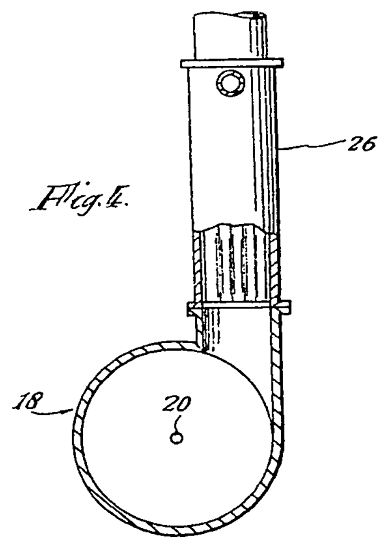

Fig. 4.